Mechanism of PTCA Dilatation in Coronary Vessels: Intravascular Ultrasound Assessment

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The mechanism responsible for luminal enlargement following PTCA remains in question. Possible mechanisms have included plaque disruption and fissuring. Stretching of nonatherosclerotic segments of the coronary wall may also play a role. Accordingly, we used intravascular ultrasound (IVUS) to assess luminal size, shape and area in ten patients immediately following successful PTCA. Luminal area at the PTCA site (8.7 ± 2.87 mm^2, mean$\pm$SD) was no different from cross-sectional balloon area in all subjects ($p>0.5$). A circular lumen was present in all subjects with a ratio of major-to-minor diameter being 1.09 ± 0.20 mm^2. In all ten subjects, circumferential atherosclerotic plaque was present at the PTCA site, with no normal appearing segments seen around the radius of the lumen.

Conclusions: IVUS demonstrates a near circular coronary lumen immediately following PTCA, similar in size to the balloon used for dilatation. Atherosclerotic plaque distribution appears circumferential in nature, thus successful dilatation with PTCA is not dependent upon stretching of a disease-free segment of the vessel wall.

IS INTRACORONARY ULTRASOUND A VALID MEANS TO ASSESS THE MECHANISM OF ATHERECTOMY?

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We have used intracoronary ultrasound to assess the contribution of vascular stretching (angioplasty effect) to the ability of atherectomy to increase the coronary lumen. Because the 1.8 mm^2 cross-sectional area of the ultrasound catheter tip may exceed the initial lumen size of coronary stenoses treated with atherectomy, the first ultrasound is performed after the first cut, which itself prominently changes the vascular lumen. If the predominant effect on vascular lumen during atherectomy occurs prior to and during the first cut, ultrasound may fail to assess the most important effect of the procedure. To assess the angioplasty effect of the first atherectomy cut using a protocol designed to minimize vascular stretching, we analyzed the angiographic stenosis lumen area at baseline and after first and final cuts during coronary atherectomy in 13 patients using a computerized quantitative angiographic analyzer.

RESULTS	Baseline	After 1st cut	Final
Lumen (mm^2) Area	0.7 ± 0.4	3.2 ± 1.3	5.9 ± 3.4
Stenosis (%)	89 ± 8	54 ± 26	32 ± 27

(Mean ± SD, $p<.05$ between each group)

Initial lumen area was less than 1.8 mm^2 in all 13 patients. The mean increase in lumen area after the first cut accounted for 46 ± 32 % of the total increase in lumen area with the entire procedure, and was less than 50% in 7 of 13 patients.

CONCLUSIONS (1) Most coronary stenoses chosen for coronary atherectomy have smaller lumina than the size of an intracoronary ultrasound probe. (2) When the atherectomy protocol is designed to minimize vascular stretching the first atherectomy cut still increases vascular lumen, but most of the increase in lumen occurs after the first cut. (3) Intracoronary ultrasound is a valid means to assess the mechanism of coronary atherectomy.

INTRAVASCULAR ULTRASOUND EVALUATION OF ACUTE AORTIC DISSECTION IN CANINES AND A HUMAN

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Treatment and prognosis of acute aortic dissection (AAD) is determined by location and extent of the anatomic lesion. Currently available diagnostic techniques have limitations defining the extent and location of the dissection. The purpose of this study was to compare intravascular ultrasound with cineangiography and pathology in a canine model of acute aortic dissection which produced a pressure gradient, mean aortic arch pressure 110 mmHg, descending aorta 40 mmHg. Real-time 360° cross-sectional intravascular ultrasound images were obtained along the length of the aorta using a 20MHz transducer mounted on the tip of an 8F catheter (CVIS) following creation and after stenting of the acute aortic dissection. Intravascular ultrasound produced diagnostic images including true and false lumens, the flap of tissue separating lumens and the length of dissection and stent. The false lumen varied from 20 to 60% of total luminal area. Three-D reconstruction of 64 or 128 ultrasound images obtained during catheter withdrawal for sequential 5cm segments of aorta during 20 second intervals provided integrated imaging of the vessel and extent of dissection. In a patient with AAD intravascular ultrasound provided an expedient method to define location, size of the dissection and spiral nature in the descending aorta. **Summary:** Intravascular ultrasound is an accurate technique to determine vessel morphology and location and extent of dissection. **Conclusion:** Intravascular ultrasound has unique potential to enhance both diagnostic and possibly therapeutic applications in the recognition and repair of acute aortic dissection.

INTRAVASCULAR ULTRASOUND OF SAPHENOUS VEIN GRAFTS AFTER PTCA AND INVESTIGATIONAL ANGIOPLASTY PROCEDURES

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Intravascular ultrasound (IVUS) imaging of saphenous vein grafts (SVG) may enhance the angiographic interpretation of results following transcatheter interventions. We used IVUS to study 18 pts with stenotic SVG treated with PTCA (n=7), atherectomy (DVI or TEC, n=8) or stent placement (n=3). In SVG, IVUS imaging did not reveal the typical 3 layer appearance of native coronaries, calcification was infrequent (11% of pts), atheroma were usually mildly echogenic ("soft"), and there were extravascular highly echogenic structures representing adjacent pericardium. Despite excellent angiographic results (reduction in % diameter stenosis from 90 ± 8 to 17 ± 8%), and concordant improvement in lumen area by US (lumen area 10.4 ± 4.6mm^2 and % area stenosis 17 ± 6), regardless of the intervention there was usually (78% of pts) significant retained atheroma at the treatment site (atheroma area 3.9 ± 1.7mm^2). Thus, angiographic improvement is mainly due to vessel wall remodelling and expansion. Principal observations obtained with each procedure were: **PTCA-** multiple superficial fissures and fractures without discrete dissections; angiographic improvement mainly from vessel dilatation. **DVI and TEC-** relatively smooth lumen surface without dissections or deep resections but significant retained atheroma. **STENTS-** concentric in the vein with refractile struts casting small shadows above compressed atheroma and an outer echogenic adventitia. Stent expansion was asymmetric axially and circumferentially and evidence of stent recoil was present. In conclusion, IVUS is an important adjunct to angiography in characterizing post-intervention results of SVG.